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Health Effects of Exposure to High Concentrations of Automotive Emissions

Studies in Bridge and Tunnel Workers in New York City

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On-site and remote health evaluations were performed on 550 employees of the Triborough Bridge and Tunnel Authority in New York City. Extremely high ambient air pollution was observed. Carbon monoxide averaged 63 ppm over a 30-day period with a maximum hourly concentration of 217 ppm in one facility. Eighty-five percent of the smoking and 47% of the nonsmoking tunnel workers had carboxyhemoglobin saturations in excess of 3%. A high percentage of the group had symptoms suggestive of chronic bronchitis; airway resistance was elevated in one third and almost all bridge and tunnel workers had an increase in closing volume, suggesting small airway disease.

Automotive pollution produced by uncontrolled emissions from multiple mobile sources has rapidly become the major air pollution problem in most urban areas. Carbon monoxide, nitrogen oxides, hydrocarbons, and oxidants are generated in large volume by the internal combustion engine and are all potentially hazardous to human health. The lack of systematic epidemiological observations and the ethical difficulty associated with large scale experimental exposure have prevented identification of precise dose-response relationships. A group of recent studies has suggested that carboxyhemoglobin concentrations in excess of 5% may induce myocardial ischemia in subjects with coronary artery disease[1-3] and long-term breathing of nitrogen dioxide concentrations averaging 2.9 ppm has been shown to produce significant pulmonary abnormalities in laboratory animals.[4] The aggregate effect of automotive pollution on human health was clearly demonstrated by Aronow et al[5] who exposed ten patients with angina pectoris to 90 minutes of Los Angeles freeway traffic. Carboxyhemoglobin saturation rose from 1.12% to 5.08%, four of the subjects developed electrocardiographic abnormalities, and the average time to develop angina with treadmill exercise fell from 249.4 to 174.3 seconds. The amount of exercise required to produce angina was significantly lower than control two hours later, when carboxyhemoglobin concentration had fallen to 2.91% saturation.

Bridge and tunnel workers, policemen, taxi drivers, and others comprise an unwitting but useful test population. Exposed daily to high concentrations of automotive pollutants, they might be considered an exaggerated model of the environmental stresses experienced by many other city dwellers. Differences between industrial and community air pollution exposures blend as the commuter travels each day through congested tunnels and highways. While an eight-hour tour of duty is considered an occupational exposure to the tunnel workers, a two-hour daily traffic period for the New Yorkers is generally considered a problem of community air pollution. Obviously, rigid distinctions between occupational and community exposures are arbitrary, and it is likely that environmental and occupational air quality standards will ultimately be similar.

The interest of the Bridge and Tunnel Officers Union and the Triborough Bridge and Tunnel Authority in the problem of automotive pollution has provided a unique opportunity to study the effects of automotive pollutants on human health. A three-year study of all nonadministrative employees of the Authority was initiated in 1970; this article details information collected during the first two years of observation. An extensive program of toll booth air purification was completed during the early months of the second year of study,

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